

REMARKS/ARGUMENTS

Favorable reconsideration of this application in light of the following discussion is respectfully requested.

Claims 5, 7, 9, 12-13, 19, 22, 24, 27, 29, and 33 are presently active in this case. The present Amendment amends Claim 33 and cancels Claims 6, 8, 10, 11, 14-16, 23-26, 28, 30-31, and 34-36.

In the outstanding Office Action, Claims 7, 8, 10, 11 and 33-36 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Capasso et al. (U.S. Patent No. 5,311,009), in view of Sze, Physics of Semiconductor Devices. Claims 13-16 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Capasso et al. and Sze, in view of Motoda et al. (U.S. Patent No. 5,737,350).

Applicant respectfully traverses, and requests reconsideration of, these rejections, as discussed next.

Independent Claim 33 is amended to include the features recited in Claims 34-35, which are now canceled.¹ Briefly recapitulating, Applicant's invention relates to a light-receiving device which converts an incident light into an electric current. The device includes an n-layer, a p-layer, and an intermediate layer. The intermediate layer includes quantum-wave interference layer units having plural periods of a pair of a first layer and a second layer. Each thickness of the first and second layers is determined by multiplying by an even number one fourth of the quantum-wave wavelength of carriers in each of the first and second layers. The intermediate layer *further includes a carrier accumulation layer* disposed between adjacent two of the quantum-wave interference layer units. The carrier accumulation layer has a band gap narrower than that of the second layer. Electrons and

¹ Claims 6, 8, 10, 11, 14-16, 23-26, 28, and 30-31 are also canceled because these claims are dependent from canceled Claim 35.

holes are excited by incident light in the carrier accumulation layer. The p-layer is applied with a positive voltage against the n-layer and excited electrons are flowed to the p-layer and excited holes are flowed to the n-layer.

The kinetic energy of the carriers, which determines the quantum-wave wavelength, is set at a level near the bottom of a conduction band and a valence band of the second layer, when the carriers are electrons and holes, respectively. The quantum-wave wavelength λ_W in the first layer is $\lambda_W = h/[2m_W(E+V)]^{1/2}$. The quantum-wave wavelength λ_B in the second layer is $\lambda_B = h/(2m_BE)^{1/2}$. The thickness of the first layer D_W is $D_W = n_W \lambda_W/4$, and that of the second layer D_B is $D_B = n_B \lambda_B/4$, n_W and n_B represent even numbers.

Turning now to the applied prior art, the Capasso et al. patent discloses a quantum well device 10 capable of producing localized states for electrons having energy greater than the barrier height. The Capasso et al. device includes a sequence of epitaxial heterolayers--barrier layers and well layers--forming a confinement quantum well 11 of thickness $n \times \lambda/2$, where λ is the deBroglie wavelength for an electron of energy E and n is an integer. Adjacent well 11, on one or both sides, are quarter wave stacks 12 of barriers 13 and wells 14 each having thicknesses of $m \times \lambda/4$ where m is an odd integer.² The individual quantum wells can have bound states, and in addition, the device can localize the resonance states. The waves reflected from interfaces in the stacks 12 constructively interfere leading to a localized concentration of probability density in the region of the confinement well 11. Thus a localized electron state is produced in the region of well 11.³

The Capasso et al. patent, however, does not teach or suggest a multiple-layer structure in which a carrier accumulation layer is sandwiched by a well layer and a barrier layer each having a thickness determined by multiplying $\lambda/4$ by an even number. Instead,

² The '009 patent at column 2, lines 20-32.

³ The '009 patent at column 3, lines 39-50.

Capasso et al.'s device merely includes the above-described sequence of barrier layers and well layers. Applicant's independent Claim 33 recites such a sandwiched carrier accumulation layer. Furthermore, there is no evidence of record that would suggest modifying Capasso et al.'s device by incorporating the claimed accumulation layer. In particular, there is no evidence that such feature would improve upon Capasso et al.'s device. There is no evidence that such modification would maintain the appropriate constructive interference leading to Capasso et al.'s localized states for electrons. The pages from the Sze document, relied upon by the outstanding Office Action, do not provide such evidence. Therefore, even if the combination of the Capasso et al. patent and Sze document is assumed to be proper, the combination fails to teach every element of the claimed invention. Accordingly, Applicant respectfully traverses, and requests reconsideration of, this rejection based on these documents.⁴

Furthermore, Applicant's multiple-layer structure includes layers which transmit electrons and holes. The Capasso et al. patent discloses a reflection layer which reflects electrons. Capasso et al.'s device is completely different from the present invention. In addition, the present invention uses a diode having pin junction structure in a forward bias, in which a p-layer functions as a positive electric potential toward an n-layer. This feature is completely different from Sze's teachings. As can be seen from the energy diagram of FIG. 10 in Sze and corresponding explanations, Sze uses an n-layer as a positive electric potential toward a p-layer, so that the electric potential gradient of the i-layer increases. Sze's diode is used under reverse bias. In Sze's diode, electrons flow to the n-layer side and holes flow to

⁴ See MPEP 2142 stating, as one of the three "basic criteria [that] must be met" in order to establish a *prima facie* case of obviousness, that "the prior art reference (or references when combined) must teach or suggest all the claim limitations," (emphasis added). See also MPEP 2143.03: "All words in a claim must be considered in judging the patentability of that claim against the prior art."

the p-layer side. By contrast, in Applicant's claimed invention, electrons flow to the p-layer side and holes flow to the n-layer side. This feature results from forming the claimed multiple layer structure, which transmit electrons and holes. Accordingly, Applicant's invention is completely different from any device, or combination of devices, disclosed by the cited prior art.

In rejecting a claim under 35 U.S.C. § 103(a), the USPTO must support its rejection by "substantial evidence" within the record,⁵ and by "clear and particular" evidence⁶ of a suggestion, teaching, or motivation to combine the teachings of different references. As discussed above, there is no substantial evidence, nor clear and particular evidence, within the record of motivation for modifying the Capasso et al. device by incorporating Sze's teachings. Without such motivation and absent improper hindsight reconstruction,⁷ a person of ordinary skill in the art would not be motivated to perform the proposed modification, and independent Claim 33 is believed to be non-obvious and patentable over the applied prior art.

Consequently, in view of the present amendment, no further issues are believed to be outstanding in the present application, and the present application is believed to be in

⁵ In re Gartside, 203 F3d 1305, 53 USPQ2d 1769 (Fed. Cir. 2000) (holding that, consistent with the Administrative Procedure Act at 5 USC 706(e), the CAFC reviews the Board's decisions based on factfindings, such as 35 U.S.C. § 103(a) rejections, using the 'substantial evidence' standard because these decisions are confined to the factual record compiled by the Board.)

⁶ In re Dembiczak, 175 F3d 994, 999, 50 USPQ2d 1614, 1617 (Fed. Cir. 1999) ("We have noted that evidence of a suggestion, teaching, or motivation to combine may flow from the prior art references themselves, the knowledge of one of ordinary skill in the art, or, in some cases, from the nature of the problem to be solved, although 'the suggestion more often comes from the teachings of the pertinent references.' The range of sources available, however, does not diminish the requirement for actual evidence. That is, the showing must be clear and particular.") (emphasis added).

⁷ See MPEP 2141, stating, as one of the tenets of patent law applying to 35 USC 103, that "[t]he references must be viewed without the benefit of impermissible hindsight vision afforded by the claimed invention."

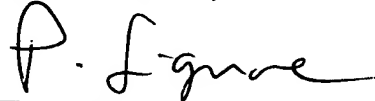
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condition for formal Allowance. A Notice of Allowance for Claims 5, 7, 9, 12-13, 19, 22, 24, 27, 29, and 33 is earnestly solicited.

Should the Examiner deem that any further action is necessary to place this application in even better form for allowance, the Examiner is encouraged to contact Applicant's undersigned representative at the below listed telephone number.

Respectfully submitted,

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